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TM 8561

x 1 x 10 Attenuator Probe

INSTRUCTION MANUAL

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MARCONI INSTRUMENTS

MP MASTER
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INSTRUCTION MANUAL

EBM 8561

for

×1 ×10 Attenuator Probe
TM 8561

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1967

MARCONI INSTRUMENTS LIMITED
ST. ALBANS HERTFORDSHIRE ENGLAND

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1 General information

1.1 INTRODUCTION

The TM 8561 $\times 1$ $\times 10$ Attenuator Probe is designed for use in measuring high frequency waveforms with rise times as short as 3 nsec and bandwidths up to about 100 MHz.

With the switch in the $\times 10$ position, a 9 MΩ resistor forms a 10:1 potential divider with the oscilloscope input resistance. To preserve the pulse response, a capacitor, comprising two concentric tubes, is connected in parallel with the resistor; by adjustment of the relative position of the tubes, the probe performance can be optimized for the oscilloscope in use. Twisting the nose of the probe allows switch contacts to short circuit the outer tube to the inner, and so convert the probe into a 1:1 device.

The nominal 3 ft 6 in coaxial connecting cable has a resistive inner conductor to give critical damping of the reflections that occur because of the impedance mismatch at each end. The inner conductor is kinked and so the cable, although flexible, can withstand considerable rough handling

Fig. 1.1 TM 8561 probe with a selection of accessories

without conductor breakage. The mechanical features of the probe are further enhanced by the silicone-rubber outer covering of the cable which is resistant to damage by a hot soldering iron.

Wide bandwidth is provided by peaking circuits in the compensating unit. During manufacture these circuits are adjusted to give negligible pulse degradation when used with 1 MΩ 15 pF oscilloscopes. The probe may also be used with oscilloscopes of 8 to 20 pF input capacitance after a simple readjustment.

If the probe is used habitually in an environment with an extremely high or low ambient temperature or with an oscilloscope that has an input capacitance greater than 20 pF, it is advisable to readjust the compensating unit as detailed in Chapter 3.

The probe may be used with frequency counters or voltmeters providing the input conditions of the device are similar to those stated in Sect. 1.2.

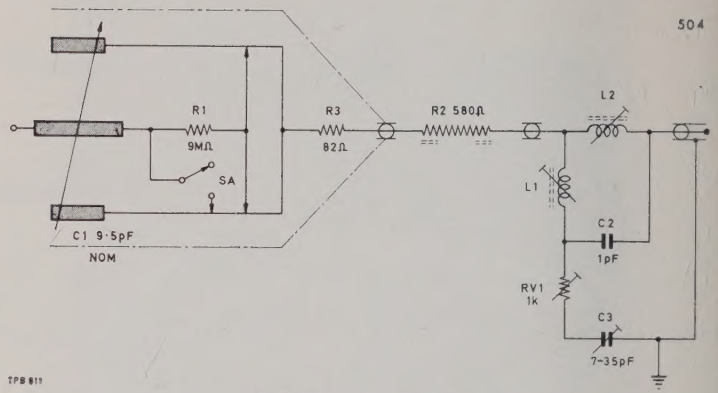


Fig. 1.2 Circuit diagram

1.2 DATA SUMMARY

Attenuation ratio	Switchable ×1 or ×10.
Input conditions	When used with a 1 MΩ 15 pF oscilloscope; ×1 resistance 1 MΩ, capacitance typically 85 pF ×10 resistance 10 MΩ, capacitance typically 10.5 pF.
Rise time	×1 rise time approximately 92 nsec when fed from a 50 Ω source with the probe connected to a 1 MΩ 15 pF oscilloscope. ×10 less than 3 nsec when connected to a 15 pF oscilloscope.
Frequency response	Typical response curves are shown in Figs. 2.1 and 2.3.
Capacitive compensation	Adjustment of the probe allows use with oscilloscopes of 8 to 30 pF input capacitance (best pulse response is obtained with a 1 MΩ 15 pF oscilloscope).
Maximum input voltage	×1: 160 V d.c. or 160 V a.c. peak-to-peak. Derated at frequencies above 5 MHz. ×10: 600 V d.c. or 600 V a.c. peak-to-peak. Derated at frequencies above 8 MHz. The formula for calculating voltage derating is in Section 2.3, also curves showing voltage derating are given in Fig. 2.5.
Cable length	3 ft 6 in (1.07 metres) nominal.

1.3 ACCESSORIES SUPPLIED

A full set of accessories is supplied with each probe.

All the probe fittings are attached by screwing on to the 6 BA thread exposed at the front of the probe.

Clip tip Enables the probe to be clipped on to a solder tag or wire, etc. To open the clip, squeeze the ring on the clip-tip body towards the similar ring on the probe body.

Other tips Five simple tips, of various shapes are supplied and are as follows:

One will fit the centre conductor of a 50 Ω BNC or type N socket. Another is similar to a banana plug and will fit a 4 mm socket. The hook tip is convenient for general servicing requirements.

The fourth type has a dimple at the end of the tip and is for use on printed boards which have plain spikes as test points.

Finally a 2 mm flexible tip is provided for semi-permanent monitoring.

Probe support clip To use, insert one end of the clip into an unused 4 mm socket on the oscilloscope front panel. A probe can then be conveniently parked by passing it between the jaws of the clip.

Cable markers Three pairs of markers are supplied, coloured—Red, Green and Blue. These may be clipped on to each end of a cable to assist identification when more than one probe is in use at a time.

Earth bayonet Provides very low inductance earth connection between the probe barrel and the equipment under test. This is of particular use when making h.f. measurements.

Earth leads Three leads, 3, 6 and 12 inches long respectively, are provided. One end of each lead clips on to the waist of either the earth bayonet or the rear end of the probe. The other end is fitted with a crocodile clip.

2 Operation

2.1 SELECTION AND USE

For most applications the probe should be switched to $\times 10$ since this allows you to connect an oscilloscope into a circuit with minimum loading and without impedance matching.

Where $\times 10$ attenuation is not acceptable, e.g. for low level, low frequency measurements, the probe should be switched to $\times 1$. This position is also useful for feeding a trigger signal to the time base without loss of amplitude.

The $\times 10$ frequency response of the probe is illustrated in Fig. 2.1 and the shunt loading effect can be established from Fig. 2.2.

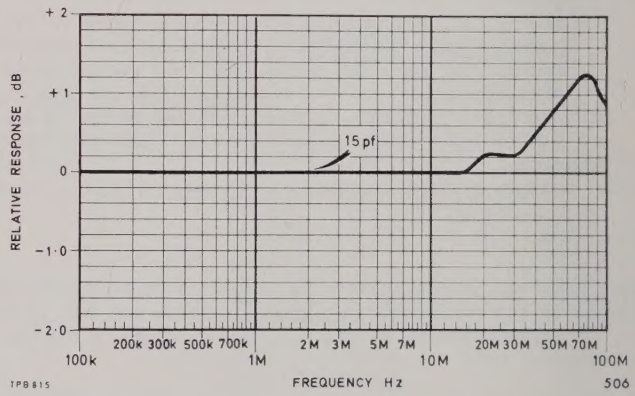


Fig. 2.1 Switched to $\times$ 10, typical frequency response curve. Relative response plotted against frequency with oscilloscope input capacitance as parameter

The overall bandwidth of any probe is affected by external factors; when the TM 8561 is switched to $\times 10$, it is dependent on the oscilloscope input capacitance. When switched to $\times 1$, the factor having greatest effect on the bandwidth is the source impedance of the signal, as illustrated in Fig. 2.3.

Three different earth leads are supplied with each probe. Each lead can be fitted by clipping on to the waist at the rear end of the probe or on to the waist of the earth bayonet attachment. Use the shortest practicable earth lead when the best frequency response or pulse shape is wanted. When using the probe with frequency counters or voltmeters, it is essential that the shortest possible earth lead is used to avoid pick-up.

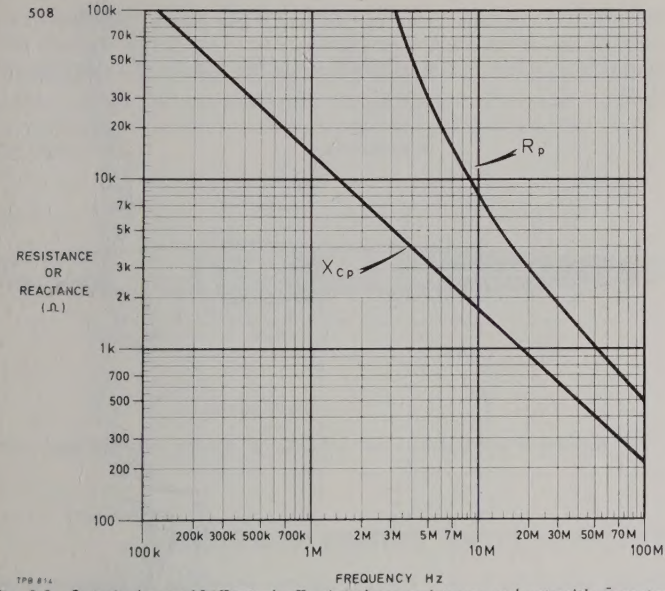


Fig. 2.2 Switched to × 10. Typical effective shunt resistance and capacitive reactance plotted against frequency. Probe connected to 1 MΩ 15 pf oscilloscope

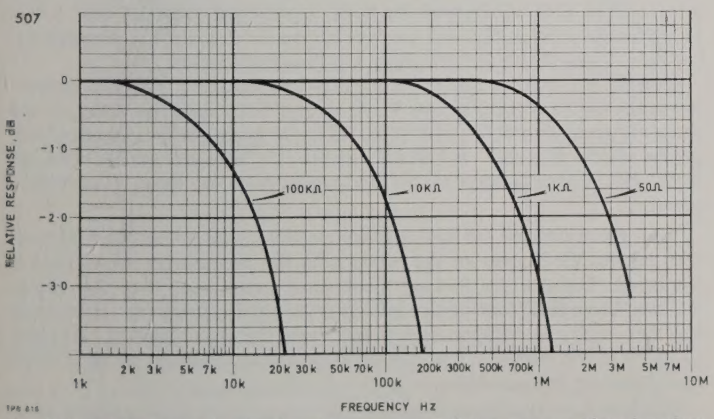


Fig. 2.3 Switched to × 1, typical response curves. Relative response plotted against frequency with source impedance as parameter; oscilloscope input capacitance 15 pf

The probe is switched from the $\times 10$ to the $\times 1$ position, or vice-versa, by turning the switch knob forming the nose of the probe through 60°. This switching action is still available when the clip tip or earth bayonet is fitted.

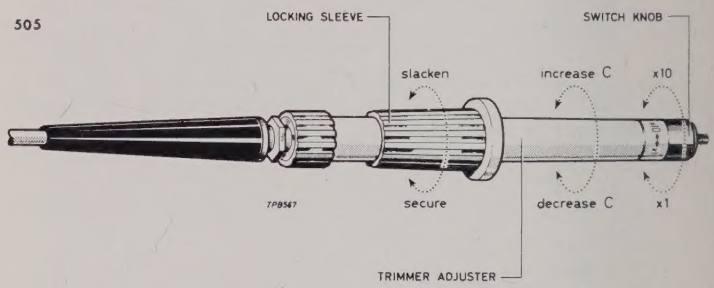


Fig. 2.4 Drawing of probe giving clear indication of rotating body and locking nut

2.2 CAPACITIVE COMPENSATION

Before using the probe, check that the capacitive compensation is correct; this is particularly important if the probe is connected to a different oscilloscope or plug-in vertical amplifier unit. During manufacture the TM 8561 is adjusted for best possible performance with 1 MΩ 15 pF oscilloscopes, but will provide adequate capacitive compensation between 8 and 20 pF by following the procedure below.

Slacken the locking sleeve, turn the switch knob to $\times 10$ and connect the probe tip to a good square wave source. Such a square wave should be flat topped with a fast rise time, ideally 1 μsec, and a repetition rate in the region of 1kHz. A suitable signal can be conveniently obtained from the bright-up terminal of an oscilloscope or from a calibrated source.

View the waveform on the oscilloscope and rotate the trimmer adjuster with respect to the rear of the probe until the best square wave shape is displayed. Tighten the locking sleeve and make sure that the setting has not been disturbed. If the setting is disturbed, hold the probe body together with the locking sleeve and turn the base bushing assembly carefully in the direction that will properly compensate the probe. Finally re-tighten the locking sleeve.

There is no capacitive compensation when the probe is switched to the $\times 1$ position.

2.3 VOLTAGE DERATING

Because of the increasing capacitive current with frequency and the dielectric losses that occur at higher frequencies, it is necessary to restrict the peak-to-peak applied voltage. Details are given in graphical form in Fig. 2.5.

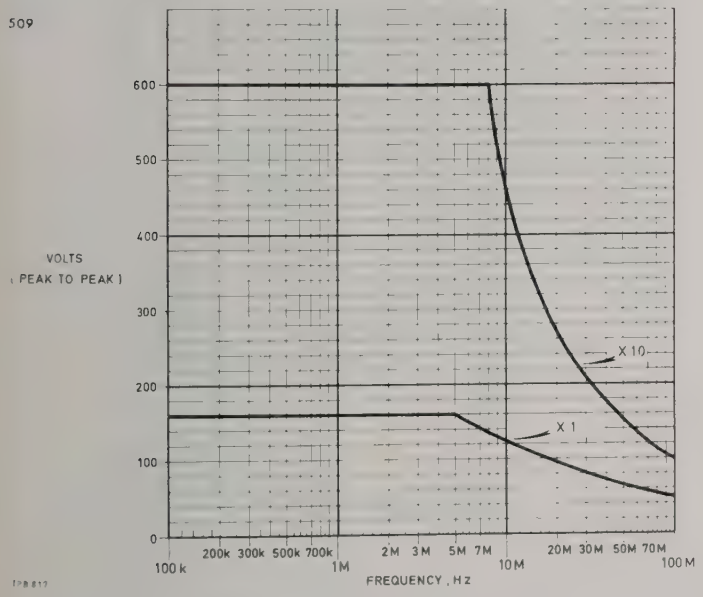


Fig. 2.5 Voltage derating curves

Where the signal consists of pulses of r.f. the full derating need not be applied. The maximum voltage under pulse conditions is $V_p \frac{V_f}{\sqrt{D}}$, where V_f is the voltage read from the derating curve at the frequency f and D is the pulse duty factor. The absolute maximum figure of 600 V peak-to-peak must, however, be observed.

2.4 EARTH BAYONET

To fit the bayonet slide it over the nose of the probe, making sure that the spring connecting finger lines up with the cut-out in the probe body which reveals the brass barrel. Push the bayonet along the probe until the spring finger is making contact with the fixed brass contact.

To adjust the length of the bayonet connection, slacken the collet chuck that holds the bayonet pin by turning the knurled locking nut. Push the pin to the desired position and afterwards lock the chuck again. The earth bayonet bracket may alternatively be used with the 3 inch earth lead by clipping this just behind the locking nut.

3 Maintenance notes

3.1 TEST EQUIPMENT

(a) High frequency oscilloscope with which probe is to be used.
(b) Nanosecond pulse generator or fast rise square wave generator. Rise time must be less than 1 nsec, repetition rate greater than 1 kHz.
(c) Short BNC-to-BNC 50 Ω lead.
(d) 50 Ω BNC termination, Greenpar type GE 84013.
(e) Probe to BNC adapter, Greenpar type GE 81034.

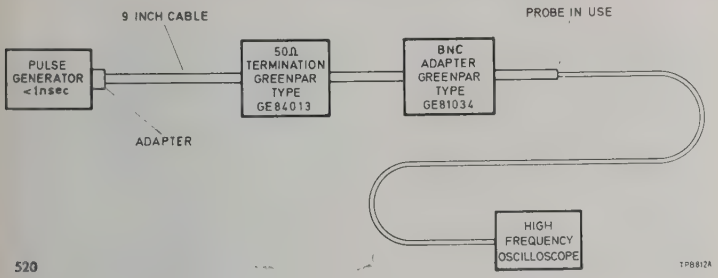


Fig. 3.1 Connections for adjusting compensation unit

3.2 PROCEDURE

(a) Loosen the locking nut on the compensating unit and move the cover back on to the cable.
(b) Set the vertical amplifier of the oscilloscope to 2 V/division and the time base to INT. A.C. triggering. Also set the sweep rate to the 200 μsec/division.
Having obtained a trace similar to one of the waveforms in Fig. 3.3, adjust the compensating capacitor C1 (probe body) for a flat top to the pulse as in Fig. 3.3a.
(c) Set the square wave calibrating source (1 μsec rise time) for 100 V peak-to-peak.
(d) Connect the BNC output plug of the probe to the vertical amplifier input socket and insert the probe, fitted with a suitable probe tip, into the inner of the CAL OUT socket of the oscilloscope. Switch the probe to · 10. A trace should now be visible on the oscilloscope screen.

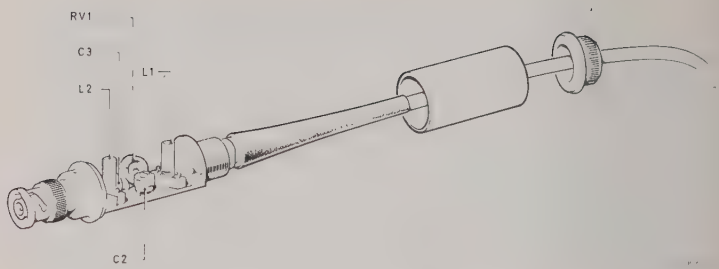
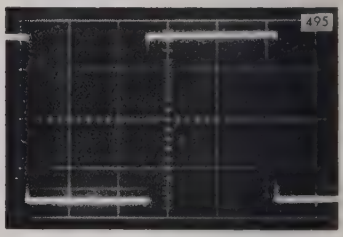


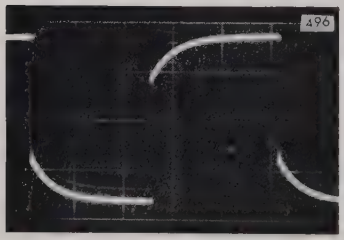
Fig. 3.2 Compensation unit showing component location

(e) If it is not, adjust the time base STABility and TRIGgering LEVEL controls, together with the horizontal and vertical SHIFT controls.
(f) Adjust C2 in the compensation unit (for location see Fig. 3.2), for minimum capacitance, i.e. adjusted for maximum overshoot.
(g) Readjust the probe to give a 5% overshoot on the waveform as in Fig. 3.3 (c), then readjust C2 for a flat response as in Fig. 3.3 (a).

Fig. 3.3 Waveforms from a calibrated source showing correct trimmer capacitance and the extremes of adjustment



(a) Correct



(b) Under compensated

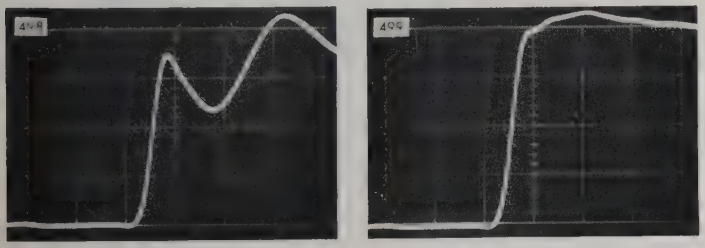
(c) Over compensated

(h) Connect the probe, using the BNC adapter, to the terminated output of a fast-rise pulse generator as shown in Fig. 3.1. Set time base to 10 nsec/division and increase the vertical sensitivity as required. If a BNC adapter is not available use the shortest possible earth connections.

(i) Adjust the time base STABility and TRIGgering LEVEL controls so as to obtain a steady display of the pulse generator waveform. Note that, in view of the high sweep speed, the INTENSITY control will need to be well advanced for the trace to be visible.

(j) Adjust the vertical GAIN and both vertical and horizontal SHIFT controls to centralize the leading edge of the waveform on the screen. The waveform may have ringing present as in Fig. 3.4 (a).

(k) Adjust RV1 until the ringing *just* disappears and a slight hump appears following the leading edge—Fig. 3.4 (b).



(a) 'Ringing' *(b) 'Hump'*

Fig. 3.4 Waveforms showing 'ringing' and 'hump'

(l) Adjust L2 to the middle of its electrical range by viewing the leading edge of the pulse. Fig. 3.5 is a double exposure showing the two extremes of adjustment.

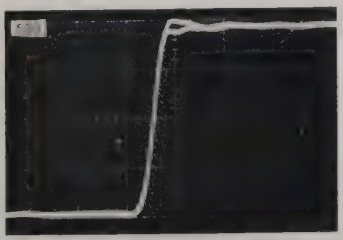
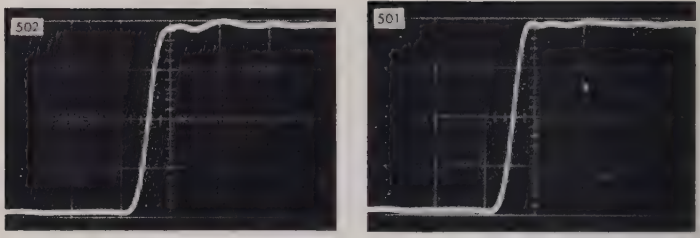


Fig. 3.5 Waveform showing maximum and minimum adjustment of L2



(a) Incorrect *(b) Correct*

Fig. 3.6 Waveforms showing incorrect and correct adjustment of L1

(m) Adjust L1 for minimum reflections following the leading edge. See Fig. 3.6.

(n) Continue to adjust L1, L2, RV1 and C2 and the probe body capacitor until the best possible pulse shape and rise time are obtained. Replace the cover on the compensating unit.

(p) Finally connect the probe as in Section 3.2 (d), and adjust as in Section 3.2 (e) for a flat pulse response.

4 Replaceable parts

When ordering replaceable parts, address the order to our Service Division (for address see rear cover) or nearest agent. Specify the following information for each part required:

(1) Type number of instrument.
(2) Description of part.
(3) M.I. code number.

Description	*M.I. code*
Barrel assembly (includes switch and 9 MΩ resistor)	44416–055
Cable assembly	44416–057
Locking sleeve, blue	37583–408
Clip tip	43145–026
Earth bayonet	44416–904
Set of accessories (excluding clip tip and earth bayonet)	41416–904

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